



National Park Service
U.S. Department of the Interior

Southeast Utah Group

2282 SW Resource Blvd.
Moab, UT 84532

435 719-2100 Phone
435 719-2300 Fax

RESEARCH 2003
RESOURCE MANAGEMENT DIVISION
Charles Schelz / Biologist
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ARCHES NATIONAL PARK

1) Project title:

**CARBON AND NITROGEN CYCLES IN ARID LANDS: THE ROLE OF
BIOLOGICAL SOIL CRUSTS AS INFLUENCED BY SOIL SURFACE
DISTURBANCE, CLIMATE CHANGE AND ANNUAL GRASS INVASION**

Name of principal investigator:

Name: Dr Jayne Belnap Phone: 435-719-2333 Email: jayne_belnap@usgs.gov

Name of institution represented:

U.S. Geological Survey

Additional investigator(s):

Name: Nicole Barger Phone: (970) 491-2689 Email: nichole@nrel.colostate.edu

Purpose of study:

Models indicate the presence of a large carbon (C) sink at temperate latitudes in the northern hemisphere. Over thirty percent of lands both globally and in the United States consist of semi-arid or arid landscapes. Very little is known about carbon dynamics in these regions. Biological soil crusts, composed primarily of cyanobacteria, algae, lichens and mosses, can completely cover plant interspaces in undisturbed areas, and constitute 70 percent or more of the living ground cover. These soil crusts can be the dominant source of nitrogen (N) for vascular plants. They fix C at a high rate and are critical for soil stability and aggregate formation, which is important in C storage. They also absorb significant amounts of CH₄. In areas where precipitation is low and soils have low fertility, native plants often rely on intact biological soil crusts to provide increased water and nutrient flow to the broadly scattered vegetation. Thus, there are many ways in which biological soil crusts influence biogeochemical cycles and the structure and productivity of the vascular plant community. Soil surface disturbance, invasive plants, and climate change have the potential to dramatically alter the structure and function of biological soil crusts. The current combination of recreational use and livestock grazing is resulting in unprecedented levels of surface disturbance on many arid lands. In regions that did not have substantial amounts of surface disturbance in the Holocene, biological soil crusts disappear readily when trampled by animals or vehicles. Exotic annual grasses are invading many of these areas. Trampling

and invasion results in reduced cover and changes in the species composition of biological soil crusts. This, in turn, leads to changes in processes such as decomposition, N and C fluxes, soil moisture, and nutrient availability to vascular plants. Decreases of only 1 percent of soil organic carbon in the top 10 cm of rangeland soils is equivalent to the total C emissions from all croplands nation-wide.

Changes in climate regimes, such as a shift in the summer monsoonal boundaries in the western United States, are expected to influence the composition and physiological functioning of biological soil crusts. Various crust components have different photosynthetic and respiration responses to temperature and moisture. In addition, different crusts have different methane fluxes. Therefore, changes in the timing or amount of temperature and precipitation is expected to alter soil C and N fluxes through changes in physiological response or crustal composition. This, in turn, can significantly impact vascular plant productivity.

This project will establish how alterations in species composition by surface disturbance, invasive grasses, and/or climate change may affect N and C inputs and fluxes, in different soils under different climatic regimes. Because current and expected changes in land use and climate will occur over millions of acres in western rangelands, impacts to soil crusts have the potential for dramatically affecting C cycles, N cycles, and vascular plant productivity over much of the western United States. In addition, semi-arid and arid ecosystems represent over one-third of the Earth's terrestrial surface, and most are covered by biological soil crusts. As human impacts are escalating both regionally and globally in these drier regions, the research questions posed in this proposal have significant implications for global C budgets as well.

2) Project title:

**THE MOAB PROJECT SITE ENVIRONMENTAL AIR MONITORING PROGRAM
- CONDUCTED BY THE U.S. DEPARTMENT OF ENERGY'S GRAND JUNCTION
OFFICE**

Name of principal investigator:

Name: Mr Joel Berwick Phone: 970-248-6020 Email: joel.berwick@gjo.doe.gov

Name of institution represented:

U.S. Department of Energy

Additional investigator(s):

Name: Michael J. Gardner Phone: 970-248-6031 Email: mgardner@gjo.doe.gov

Purpose of study:

The U.S. Department of Energy (DOE) environmental air monitoring program will monitor local and background air quality for various radio-particulates (U-nat, Th-230, and Ra-226), radon-222, and opacity (i.e., fugitive dust emissions).

3) Project title:

**THREE-DIMENSIONAL CHARACTERISATION OF FAULTS AND THEIR
INFLUENCE ON FLUID MIGRATION.**

Name of principal investigator:

Name: Dr Stuart Clarke Phone: 44 131 650 0269 Email: s.m.clarke@esci.keele.ac.uk

Name of institution represented:

University of Keele

Additional investigator(s):

Name: Charlotte Vye Phone: ++44 (0)131 650 0414 Email: cvye@bgs.ac.uk

Purpose of study:

Post-doctoral research to study the effects of faults on the migration within, and subsequent extraction of hydrocarbons from, sedimentary basins on basin- field- and trap-scale.

4) Project title:

VEGETATION DATA COLLECTION IN SUPPORT OF THE U.S. GEOLOGICAL SURVEY - NATIONAL PARK SERVICE VEGETATION CLASSIFICATION AND MAPPING PROGRAM AT ARCHES NATIONAL PARK

Name of principal investigator:

Name: Mr James Von Loh Phone: 303-721-9219 Email: jvonloh@e2m.net

Name of institution represented:

National Park Service

Additional investigator(s):

Name: Sarah Boyes Phone: 303-721-9219 Email: sboyes@e2m.net

Name: Pete Williams Phone: 970-374-2504 Email: williapa@flattops.net

Name: Daniel Niosi Phone: 303-721-9219 Email: dniosi@e2m.net

Name: Frank (Buddy) Smith Phone: 435-755-0606 Email: fsmith@mtwest.net

Name: Janet Coles Phone: 303-443-6736 Email: janetcoles1@netscape.net

Purpose of study:

The National Park Service (NPS) and U.S. Geological Survey (USGS) are cooperating to produce detailed vegetation classifications and digital databases, including vegetation maps, as part of the National Biological Information Infrastructure Program (NBII).

5) Project title:

BCS PROJECT / BARRIER CANYON STYLE ROCK ART DOCUMENTATION.

Name of principal investigator:

Name: Mr David Sucec Phone: 801-359-6904 Email: davids@networld.com

Name of institution represented:

BCS PROJECT

Additional investigator(s):

Name: Craig Law Phone: 435-752-2327 Email: claw@wpo.hass.usu.edu

Purpose of study:

The objectives of the BCS PROJECT documentation project are to record all Barrier Canyon style rock art images with archival photographic prints (gelatin-silver and ultra-stable color prints), to create a complete inventory of the documented sites, and to generate a scholarly description and analysis of the imagery.

6) Project title:

MOAB ANTICLINE EVOLUTION AND SUBSEQUENT COLLAPSE

Name of principal investigator:

Name: Mr Neil Harding Phone: 44 01506 883 152 Email: ethanp_b@hotmail.com

Name of institution represented:

Edinburgh University, Dept. of Geology and Geophysics

Additional investigator(s):

No co-investigators

Purpose of study:

To map the geology of the Western part of Arches National Park to help correlate with rock formations on the western side of highway 191 which sits in a collapsed anticline. We intend to study the whole area to try and understand why the anticline collapsed and the resulting effects it had on the geology. This is for a honours assesment.

7) Project title:

**IDENTIFICATION AND QUANTIFICATION OF SALT AND BACTERIAL
CONTRIBUTIONS TO MIRCO-EROSIONAL FORMS WITHIN THE ARCHES
NATIONAL PARK**

Name of principal investigator:

Name: Dr Robert Inkpen Phone: +44 2392 842467 Email: robert.inkpen@port.ac.uk

Name of institution represented:

University of Portsmouth

Additional investigator(s):

No co-investigators

Purpose of study:

This proposal intends to study via photographic and survey methods as well as by chemical and bacterial analysis, the distribution of micro-erosional forms within different erosional environments of the Arches National Park. Within single micro-erosional forms the distribution and action of bacterial and salt agents will be determined and related to the contextual information. Maps of erosional form distributions and the detailed analysis of the action of specific agents will be compared statistically with the location of key controlling variables such as detailed lithology and water flow regimes to determine links between variables at different scales.

8) Project title:

IDENTIFICATION AND QUANTIFICATION OF MICRO-EROSIONAL AND WEATHERING FORMS ASSOCIATED WITH TOURIST ACTIVITIES IN THE ARCHES NATIONAL PARK, UTAH

Name of principal investigator:

Name: Dr Robert Inkpen Phone: +44 2392 842467 Email: robert.inkpen@port.ac.uk

Name of institution represented:

University of Portsmouth

Additional investigator(s):

No co-investigators

Purpose of study:

This proposal intends to study via photographic and survey methods the distribution of micro-weathering and erosional forms within different humanly influenced erosional environments of the Arches National Park. These forms and their nature will be contrasted with weathering environments within the park where human activity is either absent or significantly reduced. Maps of weathering and erosional form distributions and the detailed analysis of the action of specific agents will be compared statistically to determine the relative importance of different types of human activity within particular geomorphic systems.

9) Project title:

STRATIGRAPHY AND DATING OF LOWER CRETACEOUS CEDAR MOUNTAIN FORMATION WITHIN ARCHES NATIONAL PARK

Name of principal investigator:

Name: Mr Scott Madsen Phone: 435-781-7705 Email: scott_madsen@nps.gov

Name of institution represented:

National Park Service

Additional investigator(s):

No co-investigators

Purpose of study:

Data from this study will be used to better understand the paleo-environments represented by the CMF in Arches, as well as its relationships with the CMF on a regional level. This study will be coordinated with other persons and institutions interested in working on the fossil material.

10) Project title:

**AMPHIBIAN RESEARCH AND MONITORING INITIATIVE (ARMI):
PACIFIC NORTHWEST AND ADJACENT ARIDLANDS--COLORADO PLATEAU
MID-LEVEL SURVEY SITE**

Name of principal investigator:

Name: Dr Tim Graham Phone: 435-719-2339 Email: tim_graham@usgs.gov

Name of institution represented:

USGS--Canyonlands Field Station

Additional investigator(s):

No co-investigators

Purpose of study:

1. To develop effective monitoring protocols that will provide the proportion of habitat units that host breeding populations of amphibians within selected survey areas, in a design that allows broad inference to all of Arches National Park.
2. To develop methods to effectively estimate population density and abundance in sentinel sites that will be worked intensively over each season.
3. Work with Southeast Utah Group NPS staff to enhance and expand existing water monitoring program to ensure amphibian habitats are being monitored, and to add any parameters of importance to amphibians that may not be included in current park monitoring program (e.g., dissolved organic matter, and community attributes such as plankton composition).
4. Monitor the incidence of disease in Arches amphibians.
5. Integrate findings in Arches National Park with a national amphibian monitoring program.
6. Make latest monitoring data available to the NPS via web accessible database within 3 months of data collection.
7. Compile and interpret trend information on amphibians that we collect at regular intervals and place findings into local, regional, and national contexts.

11) Project title:

ACOUSTIC MONITORING IN ARCHES NATIONAL PARK

Name of principal investigator:

Name: Mr Skip Ambrose Phone: 970-267-2101 Email: Skip_Ambrose@nps.gov

Name of institution represented:

National Park Service

Additional investigator(s):

Name: Christine Bishop Phone: 970-225-3594 Email: christine_bishop@nps.gov

Name: Christine Florian Phone: 970-225-3530 Email: Chris_Florian@nps.gov

Purpose of study:

The primary objective of this project is to provide basic acoustic data necessary for preparation of air tour management plans for ARCH. A secondary objective is to collect acoustic data that will be useful in preparing a soundscape management plan. Specifically, these data include:

1. Natural sound levels in the primary habitats/acoustic zones in ARCH during all seasons of the year; and
2. The influence of aircraft and other man-made noise on natural sound levels.

12) Project title:

NIGHT SKY MONITORING OF PARKS OF THE SOUTHEAST UTAH GROUP

Name: Charles Schelz

Email: charlie_schelz@nps.gov

Name of institution represented: National Park Service

Purpose of study

To develop protocols and gather baseline data on night sky light levels at the four units of the Southeast Utah Group. This project will result in the development of a Night Sky Long-Term Monitoring Plan and a report that will be a template for future reports. This report will detail all protocols, fieldwork required, and test site locations, it will also provide baseline data and analysis for comparison with future monitoring.

Objective 1:

A "Night Sky Long-Term Monitoring Plan" that outlines, in detail and with examples, all protocols, database management, and analysis to be performed at each test site. It will also clearly specify night sky monitoring needs and objectives. And will provide a clear understanding of how the monitoring program will support management information needs.

This plan will identify site-specific current resource impacts. It will also attempt to address future concerns and problem areas. It will set monitoring management standards for resource conditions and will identify and assign priorities to areas of greatest concern.

Objective 2:

An initial report of the first completed round of Night Sky monitoring based on the new system recommended in the Night Sky Long-Term Monitoring Plan (Objective 1). This will include all test sites at all four units of the Southeast Utah Group..

13) Project title:

**HISTORIC VEGETATION ANALYSIS THROUGH THE USE OF REPEAT
PHOTOGRAPHY AT THE SOUTHEAST UTAH GROUP.**

Name: Charles Schelz

Email: charlie_schelz@nps.gov

Name of institution represented: National Park Service

Purpose of study

Little is known of the historic vegetative cover of any of the habitats of the Southeast Utah Group. The pre-grazing condition of the vegetation has been described anecdotally, but any scientific measurement or quantitative description does not exist. The use of photography to gather this information has become our last chance to determine the pre-grazing conditions. Domestic livestock grazing was introduced into the area of the Southeast Utah Group during the late 1870's. This gives us little latitude for locating historic photographs considering photography was a new invention in the 1840's. Powell's second Colorado River expedition of 1872 had a photographer (E.O Beaman) on board and many of the original glass plates survive. Many of these photos are along the Green and Colorado Rivers but some are also in the uplands above the river. The river environment is presently being studied by Belnap and Webb (personal comm. 1998) from the confluence of the Colorado and Green Rivers south through Cataract Canyon. The Belnap and Webb study, which is utilizing historic photos, is concentrating on the river environment without much analysis of the upland vegetation communities. I propose to search out all existing historic photos that are available and piece together a picture of our upland communities as they existed before the advent of domestic livestock grazing. I also propose setting up permanent long-term monitoring photo stations at the historic photo sites that have a clear and identifiable vegetative element.

This characterization of the ecosystem vegetative change and, in particular, the condition of pristine conditions of the varied habitats of the SEUG is rated as a **Top Priority Critical Research Need** by the 1993 Southeast Utah Group Research Plan. This work may also facilitate the understanding of the history of the invasion of exotic species into the area and the impacts of visitor use.

OBJECTIVES: Gather baseline historic photographic data and develop a long-term photographic monitoring program on vegetation change in Arches and Canyonlands National Parks, and Natural Bridges and Hovenweep National Monuments (The Southeast Utah Group).

- 1) Locate all existing historic photographs and in particular pre-1880 photos of the area that encompasses the Southeast Utah Group.
- 2) Determine the location of each photo with vegetative analysis possibilities and establish a permanently marked and documented photo-station for past, present, and future analysis of vegetation change.

- 3) Analyze historic and repeat photos for species composition and cover change. Also, to look at visitor use impacts.
- 4) Produce a final report, and lay the foundation for subsequent reports and monitoring that will assist National Park Service managers in developing resource management plans that could protect habitats of the Southeast Utah Group. This information will help in assessing impacts of internal and external operations, and visitor impacts.

14) Project title:

LOMATIUM LATILOBUM MONITORING IN ARCHES NATIONAL PARK

Name: Charles Schelz

Email: charlie_schelz@nps.gov

Name of institution represented: National Park Service

Purpose of study

To establish a long-term monitoring program for the Arches biscuitroot (*Lomatium latilobum*) in Arches national Park. The existing monitoring program will be analyzed and updated. New protocols will be added and old protocols may be abandoned. The final report will detail all protocols, fieldwork required, and site locations.

Main objectives are to monitor population size and potential visitor and natural impacts.